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is to be dealt with in a forthcoming volume in the Cambridge Public Health Series by Dr. W. E. Adeney. This also will be welcomed by American readers. Another omission is that of the process so largely and successfully used in New England, the process of intermittent sand-filtration.

The author's treatment of septic tanks and their limitations is extremely interesting. He describes not only the hydrolytic tank by Dr. Travis and the Imhoff tank, but also the Kremer and Fieldhouse tanks, which are not as well known in this country. Greater attention is given to the disposal of sludge than in many books and the subject of trade wastes and their disposal is also treated at considerable length.

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PROCEEDINGS OF THE NATIONAL ACADEMY OF SCIENCES

(NUMBER 5)

THE fifth number of volume 1 of the *Proceedings of the National Academy of Sciences* contains the following articles:

1. *Some Problems in Stellar Photometry*: JOEL STEBBINS, Astronomical Observatory, University of Illinois.

This was a part of the address of Mr. Stebbins as Draper Medallist before the Academy on April 20, 1915. It contains a number of suggestions as to probably fruitful methods and problems of stellar research with the aid of the photometer.

2. *The Composition of Brachiopod Shells*: F. W. CLARKE and W. C. WHEELER, United States Geological Survey, Washington.

The authors present an investigation to determine, more definitely than hitherto, just what substances are contributed by each group of marine invertebrates to the marine sediments, with a special reference to the formation of magnesian and phosphatic limestone.

3. *On the Occurrence of the Line 4,686A and the Related Series of Lines in the Spectra of the Planetary Nebulæ*: W. H. WRIGHT, Lick Observatory, University of California.

The line 4,686A and related series of lines as observed in the spectra of heavenly bodies, and more recently obtained from laboratory sources, have played an important rôle in some theories of the constitution of atoms; and Mr. Wright here presents a number of observations concerning the different forms in which line 4,686 occurs in nebulæ. In particular, he observes that it appears either as a narrow line in the nebulosity or as a broad band in the nucleus; rarely in both forms.

4. *The Nature of Nerve Conduction in Cassiopea*: A. G. MAYER, Department of Marine Biology, Carnegie Institution of Washington.

The nature of nerve conduction appears to be some chemical reaction involving the adsorbed sodium, calcium and potassium cations, and its rate is proportional to the concentration of these absorbed ions, and is thus a surface effect. The work, therefore, supports other recent work by Tashiro and Lillie.

5. *A New Canonical Form of the Elliptic Integral*: B. I. MILLER, Department of Mathematics, Johns Hopkins University.

A new canonical form of the elliptic integral is suggested which has the advantages over the Klein-Bianchi form that it is simpler in form, unique and invariant under certain transformations.

6. *The Structure of Complex Atoms and the Changes of Mass and Weight involved in their Formation*: W. D. HARKINS and E. D. WILSON, Kent Chemical Laboratory, University of Chicago.

This is a contribution to a subject at present very widely discussed as to the nature of the atom. The authors find that it is possible to construct the various atoms of low atomic weight out of the helium and hydrogen atoms. The departure of the atomic weights from integral values on the hydrogen basis is attributed to the fact that the interference of the electric charges in the nucleus of the helium atom produces a diminution of the electromagnetic mass sufficient to lower the atomic weight; and close coincidence of the atomic weights with integral values on the oxygen basis is taken to indicate that the diminution

of mass occurs mostly in the formation of the helium atom and scarcely at all in the combination of helium and hydrogen atoms into the atoms of higher atomic weight.

7. *Huntington's Chorea in Relation to Heredity and Eugenics*: C. B. DAVENPORT, Station for Experimental Evolution, Carnegie Institution of Washington.

Nearly 1,000 cases of Huntington's chorea are traced back to some half dozen individuals. The choreic movements never skip a generation and in other respects show themselves clearly to be a dominant trait; nevertheless, there is no clear evidence that persons belonging to the choreic lines voluntarily abstain from marriage, or are selected against in marriage.

8. *The Alcyonaria as a Factor in Reef Limestone Formation*: L. R. CARY, Department of Biology, Princeton University.

To determine the amount of material contributed to reef formation by the gorgonians three factors are taken into consideration: first, the amount of lime held as spicules in the tissues of these colonies; second, the bulk of the gorgonians present on any reef area; and third, the number of colonies which will set free their spicules through the death and subsequent disintegration of their coenenchyma.

9. *Transformations of Conjugate Systems with Equal Invariants*: L. P. EISENHART, Department of Mathematics, Princeton University.

The author has previously described what he has called "transformation K " and "transformations Ω "; and in this note he shows that there is a fundamental relation connecting those transformations.

10. *On the Pole Effect in the Iron Arc*: C. E. ST. JOHN and H. D. BABCOCK, Mount Wilson Solar Observatory, Carnegie Institution of Washington.

In a continuation of their communication in the March number of the *Proceedings*, the authors find that it is necessary to consider the pole effect in the determination of wavelengths in international units. The wavelengths are not affected by wide variations of

density of the radiating vapor and appear to be independent of changes in temperature. The pole effect does not occur in vacuo and appears independent of electrical conditions.

11. *Inheritance in the Asexual Reproduction of Hydra Viridis*: K. S. LASHLEY, Zoological Laboratory, Johns Hopkins University.

This investigation aims to contribute to the answer of the questions: Do heritable variations commonly occur among the offspring of a single individual multiplying asexually? and may selection among such offspring produce strains differing in hereditary characters? He finds that the only effect of selection is a temporary change in the vigor of the selected polyps and that there is no cumulative inheritance of variations in the number of tentacles within the clone. There is some evidence that the same conclusions apply to the inheritance of size.

12. *On the Monticellite-like Mineral in Meteorites and on Oldhamite as a Meteoric Constituent*: G. P. MERRILL, Department of Geology, United States National Museum, Washington.

The author has subjected to microchemical analysis and to optical study the colorless mineral whose presence in chondritic meteorites has been observed by several previous investigators. He presents sectional drawings showing the appearance and optical properties of the mineral, which appears to be a form of calcium phosphate. He also calls attention to the presence of oldhamite (calcium sulphide) in meteorites from various sources.

13. *Absolute Scales of Photographic and Photovisual Magnitude*: F. H. SEARES, Mount Wilson Solar Observatory, Carnegie Institution of Washington.

Mr. Seares describes the arrangement at the Mount Wilson Observatory for determining absolute scales of photographic and photovisual magnitudes extending over about $17\frac{1}{2}$ magnitudes for the photographic scale and about $15\frac{1}{2}$ for the photovisual scale. The various difficulties which are met in comparing stars so different in brightness as is implied in these ranges of magnitudes are discussed,

and the details of the method employed are indicated.

14. *Mitosis in Trichomonas*: C. A. KOFOD and O. SWEZY, Zoological Laboratory, University of California.

The authors conclude that cell-division in trichomonad flagellates is a true mitosis with differentiated chromosomes, which split longitudinally prior to their location in the equatorial plate; that the nuclear membrane persists throughout mitosis; that the paradesmose between the migrating blepharoplasts is extranuclear at all times, disappears after nuclear division, and does not give rise to the axostyle; and that the axostyle splits longitudinally and thus forms two daughter axostyles.

The number concludes with the report of the annual meeting (which has already appeared in *SCIENCE*) by the home secretary, and with announcements of the research grants made from the trust funds of the academy during the preceding year.

SPECIAL ARTICLES

THE CONTINUOUS SPECTRA OF GASES

IN spectroscopic literature there are many casual references to a continuous background in the vacuum-tube spectra of various gases, such as oxygen, chlorine, etc. Usually these observations appear to have been confined to the visible region, and I can recall no comments on continuous spectra in the ultra-violet except in the case of hydrogen. Schniederjost¹ and Friederichs² observed such a spectrum at low pressures, which extended to a wave-length of about 2,100. The latter attempted to use the uncondensed discharge through a small capillary tube at about 2 mm. pressure as a source for the photography of absorption spectra, but found that the results were unsatisfactory, even with exposures varying from twelve to twenty-four hours.

In photographs of the hydrogen spectrum obtained with a large two-prism quartz spectrograph I have frequently observed this continuous spectrum. Although the resolving power of this spectrograph in the extreme ultra-

violet is greater than that of a five-inch grating in the first order, there is no evidence of resolution into lines or bands. The spectrum appears to be uniformly continuous, and it seems likely that its gradual fading out in approaching the wave-length 2,100 is due rather to the absorption of the thick quartz system than to the lack of these wave-lengths in the emitted light. It appears to be due to pure hydrogen, for successive improvements in purity due to the removal of oxygen, water vapor, and nitrogen cause no noticeable change; nor does the addition of a trace of oxygen to hydrogen previously freed from that gas as far as possible cause any appreciable difference.

It seems very unlikely that a continuous spectrum can arise from free vibrations within the atom or molecule, hence it has been usually ascribed to molecular collisions. In comparing different gases at the same pressure, the number of collisions would depend mostly on the mean velocity of the molecules, so that the number of collisions would rapidly diminish as the molecular weight increases; hence we might expect that the continuous spectrum of a light gas would be stronger than that of a heavier gas. This was found to hold good for hydrogen, helium and neon. Photographs were obtained of the spectra of these three gases in vacuum tubes prepared by Hilger. The pressure was about the same in all. With a two-minute exposure, the continuous spectrum of hydrogen was very intense; that of helium about half as strong, and that of neon about one third as strong. They all extended to about the same limit—that set by the transparency of the quartz. In all these cases the uncondensed discharge of a medium-sized induction coil was used. The introduction of a condenser almost completely obliterated the continuous spectrum. When a condenser is used the radiation probably comes from dissociated ions, with free periods little disturbed by molecular collisions.

Nitrogen, krypton and xenon did not show any continuous spectrum.

Some tests showed that hydrogen tubes may render excellent service as sources for the

¹ Schniederjost, *Zt. f. Wiss. Phot.*, p. 265, 1904.

² Friederichs, *Bonn Diss.*, 1905.